Vaccinations

- Vaccination: the artificial induction of actively-acquired immunity by administration of a non-pathogenic form or component of a disease-causing agent. Vaccine a form of a pathogenic agent modified to make it non-pathogenic and suitable for use in vaccination. Natural immunity: a result of naturally-acquired disease, gives the strongest, most specific, and most long-lasting immunity to disease, high risk of damage to the body due to the disease. Artificial immunity: a result of vaccination, weaker, less specific, and shorter immunity to the disease, low risk of damage to the body from the vaccine. Vaccine should not be pathogenic, instead should be immunogenic and induce high concentrations of antibodies and t cells. Attenuated microbe vaccines have the mutant of the wild- type of the microbe, so it is limites in its ability to infect the body, therefore deemed non- pathogenic. Developed by culturing microbe through sub-cultures in an unnatural host e.g. cell cultures for virus, artificial media for bacteria. E.g. BCG tuberculosis vaccine developed by cultures in sub- optimal media.

- Advantages: give strong, long-lasting immunity due to amplification of the immunogenic stimulus by growth of the microbe in the body, can be given by a local route to induce a strong local antibody response, such the polio vaccine - given by mouth. Disadvantages: important immunogenic antigens of the vaccine might not be identical to those of the wild-type microbe due to the mutation, difficult and expensive to develop due to the need to prove that the mutant microbe is non-pathogenic. **Killed microbe vaccines:** advantages: less risk of change in immunogenic specificity, relatively easy and cheap to produce as safety testing is simpler. Disadvantages: large amounts are needed to induce immunity, immunity is relatively weak and short- lived. **Inactivated toxin vaccines:** use purified protein toxin inactivated by reaction with formaldehyde to form a toxoid which has the same immunogenic specificity but is non-toxic. Toxin is purified from microbial culture fluids without difficulties, formaldehyde treatment causes only small alterations in the shape of the toxin protein so retaining immunogenic specificity, the toxoid is partially to remove excess formaldehyde and constituents of the microbial culture medium e.g. tetanus vaccine, diphtheria vaccine. Advantages: purity of vaccine can be high and adverse reactions are rare, immunity is highly specific. Disadvantages: only applicable to diseases caused by toxigenic bacteria in which the main symptoms are caused by the toxin, the toxoid molecule is small so immunogenic stimulus has to be enhanced by mixing it with an adjuvant such as aluminium hydroxide. **Purified sub-unit vaccines:** uses microbial molecules which are significant in pathogenesis

- of the disease, these may be microbial attachment molecules, or microbial anti-phagocytic molecules. Method of preparation: the significant molecules are extracted, the treatment kills the microbe so further treatment to make the vaccine non-infectious may not be needed. E.g. influenza vaccine (viral surface haemagglutinin molecule), Haemophilus meningitis vaccine (capsular polysaccharide

- molecule). Advantages: purity is high and adverse reactions are rare, protein sub-units may be produced in non-pathogenic microbes by genetic engineering techniques making production much safer. Disadvantages: immunogenicity of polysaccharides needs to be enhanced, eg by mixing with an adjuvant, or by conjugation with a harmless protein. Multiple genetically-engineered vaccines: the immunogen is a vaccine strain of a microbe containing cloned genes coding for the significant pathogenic proteins of several different pathogenic microbes. may be used to immunise against several diseases at once. Nucleic acid based vaccines: Methods of formulation and delivery have improved. Appear to be extremely effective and successful.

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Discussion